Space Weather Technical Forecast

Issued on Tuesday, 27 September 2022 at 13:29 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Likely G1/Minor, chance of G2/Moderate, slight chance of G3/Strong geomagnetic storms Day 1 (27 Sep), perhaps early Day 2 (28 Sept), and then late day 4 (30 Sept). Chance of R1/Minor Radio Blackouts throughout. Slight chance of Active fluence.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low with several C-class flares observed, mostly from AR3107. The peak flare was a C4.8 at 27/0646 UTC from AR3107. This is one of six active regions on the disc, and is also close to AR3105 in the southern central disc. No growth has occurred in either region, although both are fairly complex, with both showing gamma configuration and AR3107 recently developing a delta spot near it's leading portion. The largest region, in terms of area, is currently AR3110 in the northeast quadrant but this has a simpler magnetic layout. There are also three further small and simple regions on the disc. No Earth-directed CMEs have been observed in the last 24 hours.

Solar Wind / Geomagnetic Activity: Solar wind parameters have indicated a recent combination of HSS (CH26/-) and CME arrivals. The solar wind speed, as measured by DSCOVR at L1, has risen to 500-550km/s. The density started above average then gradually rose to well above average, with a maximum of 92ppcc by 27/0051 UTC, before falling back to around average. The total Interplanetary magnetic field strength, Bt, became briefly Very Strong with a max value of 31 nT at 27/0429 UTC, then declined back to Strong. The north-south component, Bz, followed a similar trend but stayed mostly positive during much of the Strong and Very Strong periods, with fluctuations between +30/-17nT. The phi angle started and ended mostly negative (towards the sun) but with intermittent periods of positive (away from the sun) between 26/1630- 27/0405 UTC. Geomagnetic activity was Quiet to Active (Kp 0-4), with two G1/Minor storm periods during the first two periods of 27th September UTC.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured at GOES16, remained slightly raised above normal background levels with a recent upward trend, but has remained well below S1 levels. High energy electron flux (greater than 2 MeV) peaked at High levels, reaching 2640 pfu at 26/1640 UTC, then fell back to background from 26/2320 UTC. The associated 24-hour fluence was just below the Active (1e8 integrated pfu) threshold, now on a declining trend. Observed fluence at 27/0000UTC was 7.67e7 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is forecast to be generally Low, with a chance of isolated M-class flares, primarily from AR3107.

Solar Wind / Geomagnetic Activity: Solar wind speeds are currently elevated and expected to be slightly elevated to elevated through much of the period before the HSS from Ch27/+ arrives late day 4 (30th) or perhaps day 5 (1st Oct). Last rotation this CH gave strong solar wind speeds above 700 km/s, and a brief G3/Strong storm interval near the onset. A similar forecast this rotation is not unreasonable.

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Geomagnetic activity is therefore likely to be Unsettled to Active with likely G1/Minor storm intervals, a chance of G2/Moderate storms and a slight chance of G3/Strong storms day 1 (27th), perhaps lasting until early day 2 (28th), before becoming Quiet to Unsettled from late day 2 (28th). A further similar increase is expected from late day 4 (30th) onward.

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux is expected to persist at background levels, with a slight chance of reaching S1, most likely from AR3107 and AR3105. The high energy (greater tan 2MeV) electron flux will likely remain background initially, perhaps rising to moderate or high levels later in the period. The associated 24 hour fluence is most likely to remain below the Active (1e8 integrated pfu) threshold, but with an upward trend toward into day 3 or day 4 (29th or 30th), with a chance of becoming Active by day 4 (30th).

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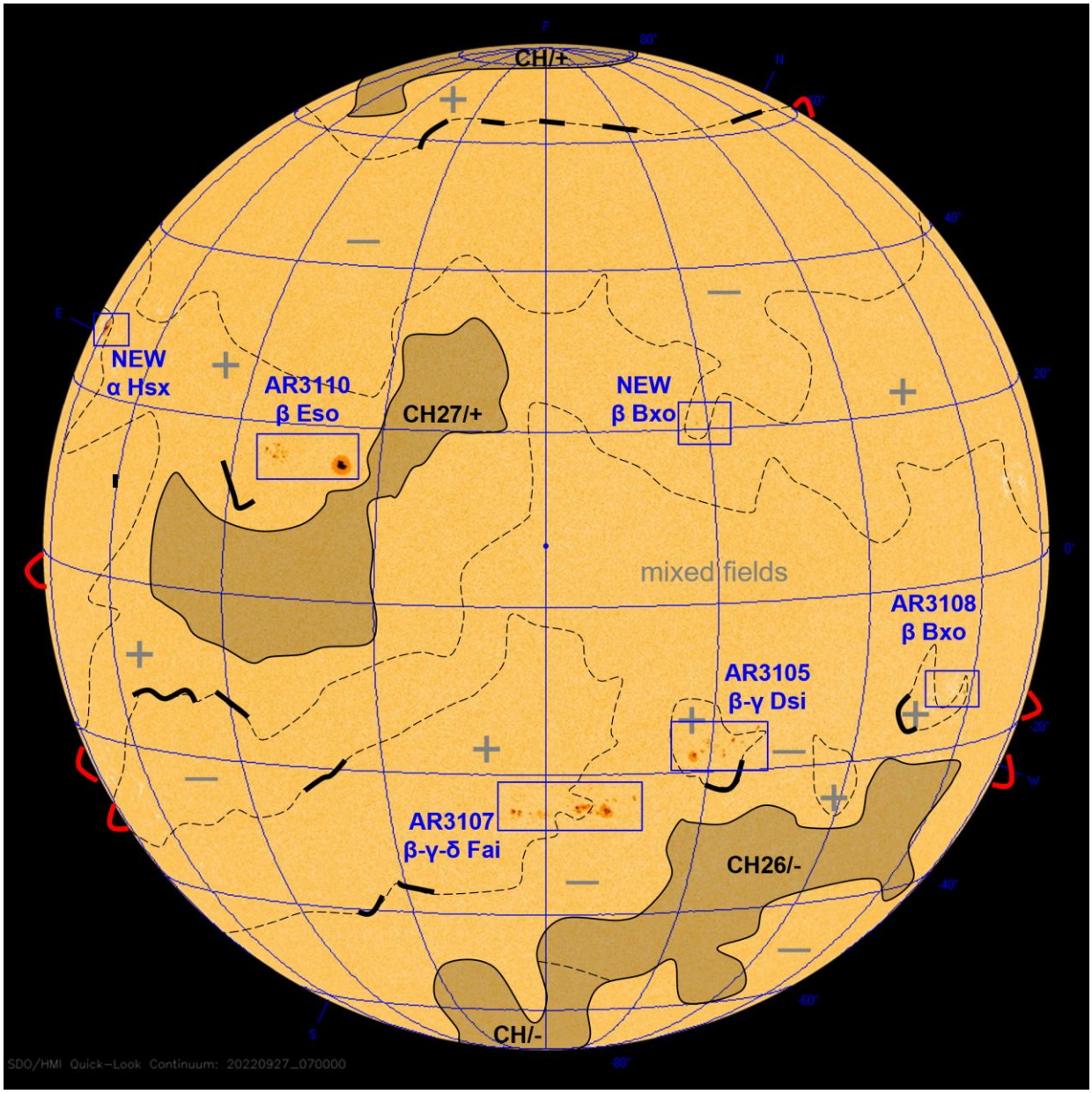
Figure 1. Solar Analysis Valid 27/0700 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

Solar wind speeds are currently elevated due to the combined arrival of CH26/- and CME/s. Solar winds speeds are expected to fall slightly back to slightly elevated by day 2 (28th) or day 3 (29th) due to waning HSS effects.

The HSS from Ch27/+ is then expected to arrive from late day 4 (30th) or perhaps day 5 (1st Oct) and continue through the weekend UTC. Last rotation this CH gave strong solar wind speeds above 700 km/s, and a brief G3/Strong storm interval near the onset. A similar forecast this rotation is not unreasonable.

Geomagnetic activity is therefore likely to be Unsettled to Active with likely G1/Minor storm intervals, a chance of G2/Moderate storms and a slight chance of G3/Strong storms day 1 (27th), perhaps lasting until early day 2 (28th), before becoming Quiet to Unsettled from late day 2 (28th) and into day 3 (29th). A further similar increase is expected from late day 4 (30th) onward, with likely G1/Minor storm intervals, a chance of G2/Moderate storms and a slight chance of G3/Strong storms.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	60	50	20	60
Strong	G3	No	10	5	1	10
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
22/2058	Partial	Coronal Dimming	NW	400 km/s	Early 27th	Low Confidence, may have been the arrival already observed.

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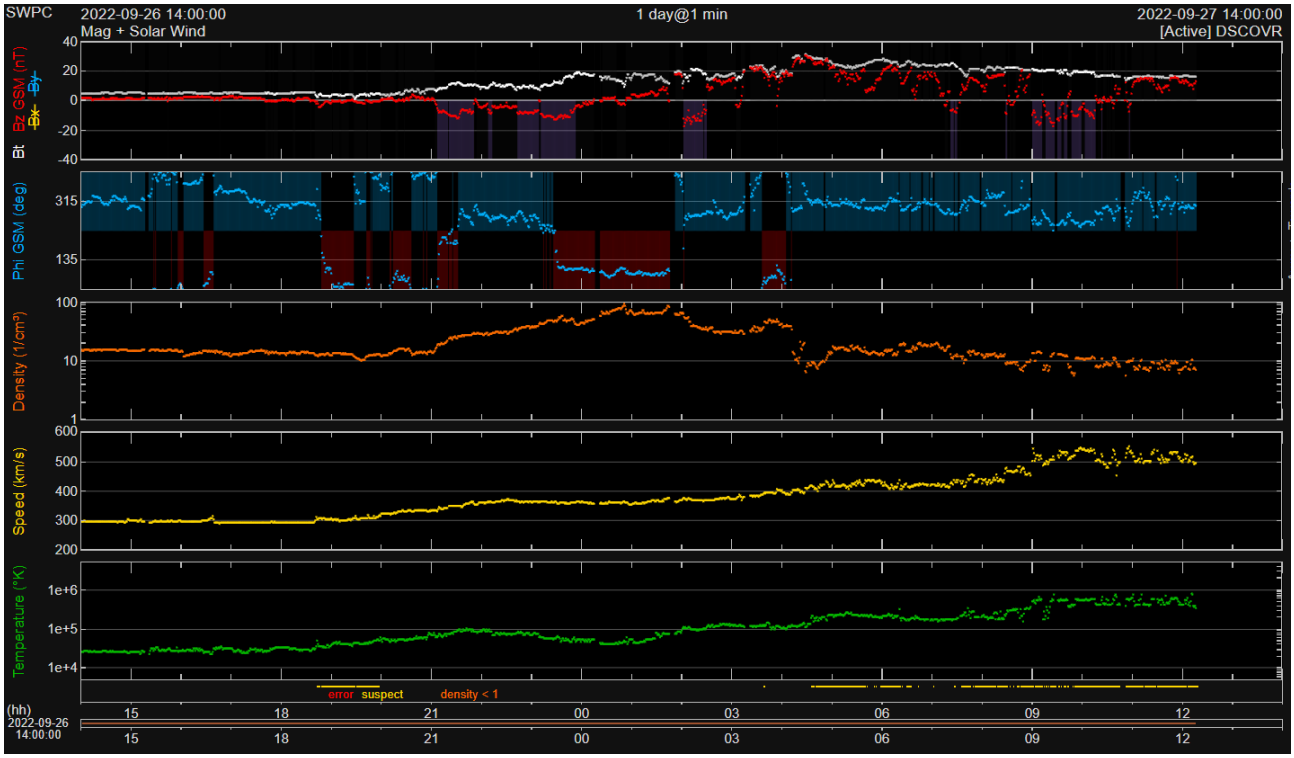
Figure 2: Solar wind parametres past 24 hours.



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Radio Blackouts - X-Ray Flares:

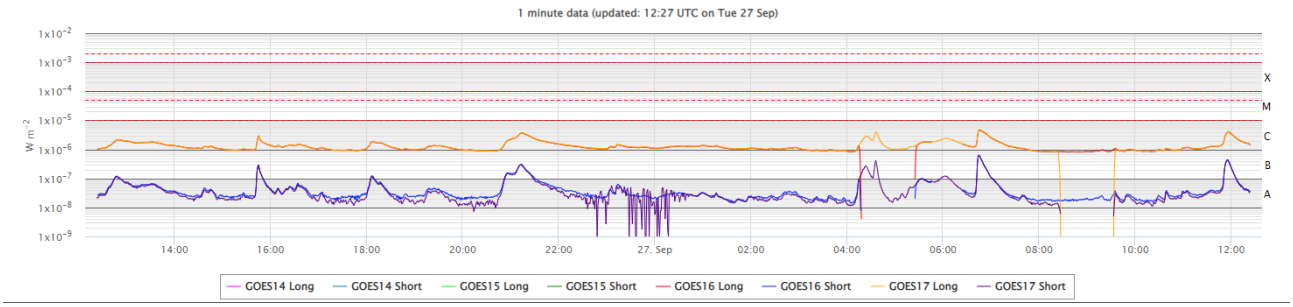
Solar activity has been Low with six sunspot regions on the disc. Low activity is likely to continue, with a chance of isolated M-flares.

Three regions are of moderate longitudinal extent. AR3110 is the largest of these, though a relatively simple bipolar region. AR3107 is the longest region, now classified as a beta-gamma-delta due to the mixed polarity of connected spots in it's leading portion, though it is showing signs of reduction in areal extent. AR3105 is also showing signs of decline and has been reclassified due to the apparent penumbra symmetry of the trailing spot region.

The other main region of note is AR3110 (Eso/Beta) in the northeast. This has the largest penumbral areal size of the current spots, and also has the potential for M-flaring, but is currently a simple and stable bipolar region. The other regions appear mainly small and simple, although the new region rotating onto the northeast limb may not be fully visible and could yet reveal trailing spots.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	30	30	30	30
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: Xray flux trace past 24 hours.



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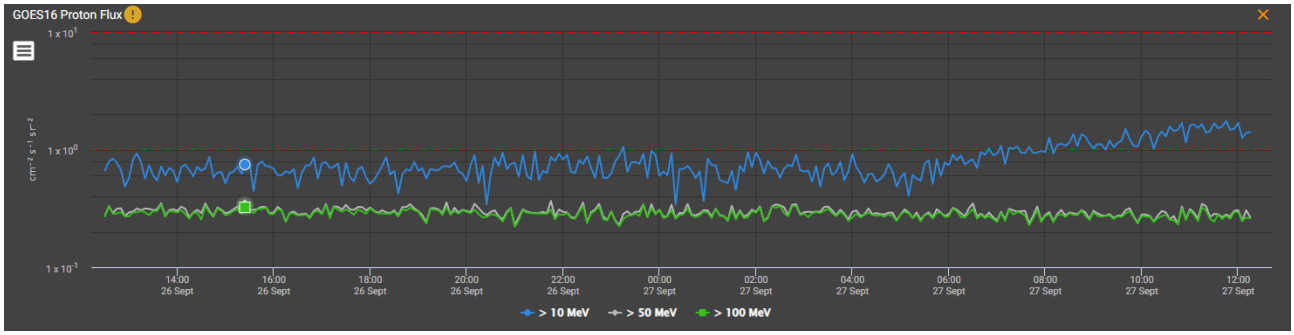
Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10MeV) observed by GOES16 is expected to remain at background or moderate levels. A slight enhancement is ongoing with a rising trend at present, therefore values have been adjusted upward for the remainder of the period, with a slight chance of S1 radiation storms. The main risk of these further proton enhancements is from AR3105 and AR3107.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	15	15	15
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: Proton trace past 24 hours.



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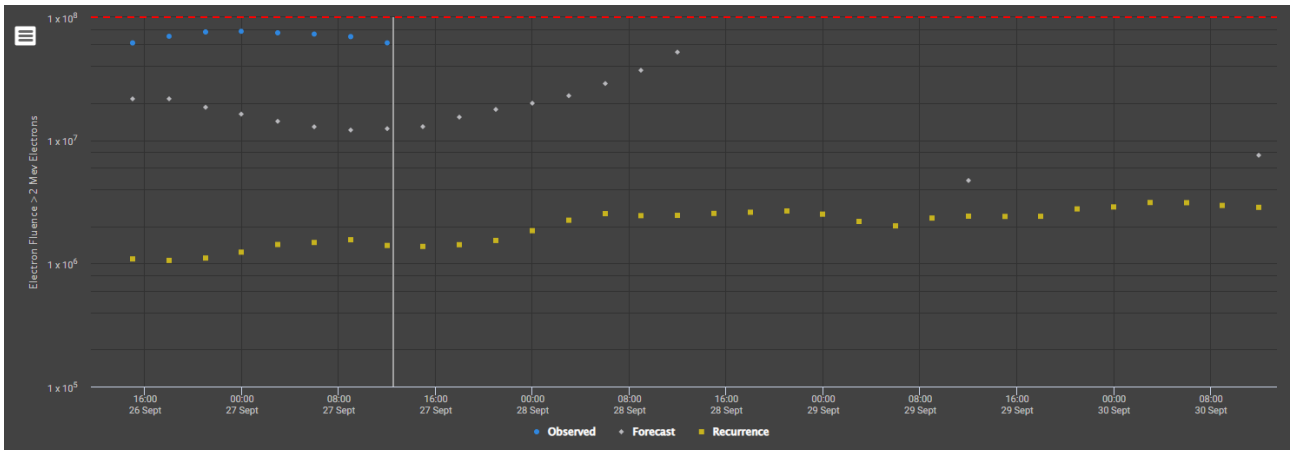
High Energy Electrons Event (≥ 2MeV):

The high energy (greater than 2MeV) electron flux, as observed by GOES-16 has recently dropped likely due to the recent arrival of the HSS from CH26 combined with some possible weak CME influence. As such peak values have already been seen and we are now on a declining trend. Any response to the current HSS is unlikely to occur until near the end of the period.

The associated electron 24 hour fluence is most likely to remain below the Active (1e8 integrated pfu) threshold, and on a declining trend. Subsequent fluence levels depend strongly on how fast the wind speed associated with CH26 remains, and any further geomagnetic activity associated with it. Fluence levels may rise toward the end of the period. REFM is currently considered to be giving poor short term trend guidance, though longer term trends are considered more likely, these probably staying below Active fluence.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	10	30
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 5: REFM integrated flux/fluence forecast, oberstations and persistance.



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